EXPRESS MAIL NO. EV447224660US

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Stephen V.R. Hellriegel et al.
Application No.	:	10/012,210
Filed	:	November 5, 2001
For	:	ELECTRICAL CONNECTOR WITH STRAIN RELIEF STRUCTURE

Examiner	:	Tuan T. Dinh
Art Unit	:	2827
Docket No.	:	901115.435
Date	:	February 17, 2004

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' BRIEF (37 C.F.R. § 1.192)

Dear Sirs:

This brief is in furtherance of the Notice of Appeal, filed in this case on October 16, 2003. The fees required under Section 1.17(c) are enclosed with the accompanying fee transmittal. Applicants hereby request any extension of time necessary for acceptance of this Appeal Brief, and any other fees which may become due, and authorize said fees be charged to Deposit Account No. 19-1090.

I. REAL PARTY IN INTEREST

The real party in interest is Cray, Inc., which is the current name of the assignee of the present invention.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which directly effect or will be directly effected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-17 are currently pending and active in the application. Of these claims, claims 14-17 are rejected under 35 U.S.C. § 112, first paragraph as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Claims 1, 2, 4, and 6-8 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Stopperan. Claims 3 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Stopperan in view of Furnival. Claims 9-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over admitted prior art (Figures 1 and 2 of the present application) in view of Furnival. The current active claims are attached as Appendix A.

IV. STATUS OF AMENDMENTS

The Final Rejection was mailed July 16, 2003. In response to this Final Rejection, a Notice of Appeal was filed on October 16, 2003. No amendments after final have previously been filed. An amendment to correct a typographical error in Figure 5 is submitted herewith, and its entry is requested. The claims now pending in the application were those filed in the Amendment dated April 2, 2003.

V. SUMMARY OF INVENTION

One type of connector used in high performance computers is a flexible substrate having a plurality of small metal contact pads on the surface. The flexible substrate is aligned with corresponding contact pads on a circuit board and a controlled pressure is applied to bring the contact pads of the substrate into firm electrical contact with those of the circuit board. Connectors of this type often have contact densities exceeding 300 or 400 contacts per square inch. As contact densities increase on such connectors an ever larger percentage of the surface area of the flexible substrate is occupied by metal contact pads. As density increases, the flexibility of the substrate is reduced by the higher and higher percentage of surface area that is occupied by the inflexible metal structures of the contact pads. At the same time, the distance between contacts becomes smaller.

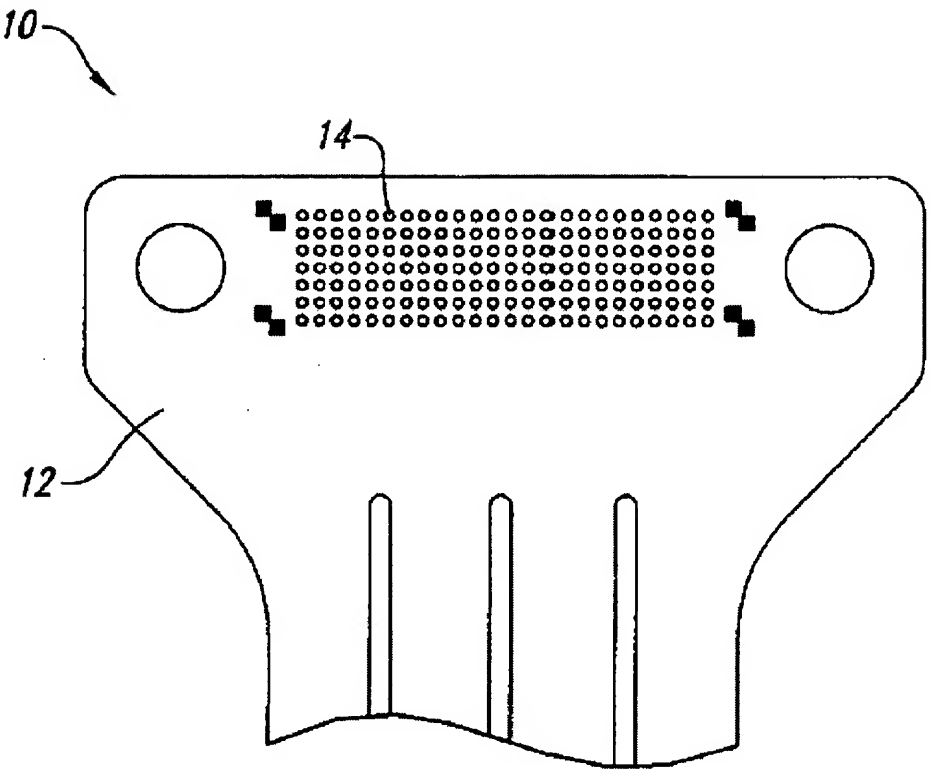

Fig. 1

Figure 1 illustrates a connector of the type described, on which the contact pads are arranged with a density of about 400 pads per square inch. Figures 3 and 4 illustrate some of the difficulties that can occur when using high density connectors such as that illustrated in Figure 1.

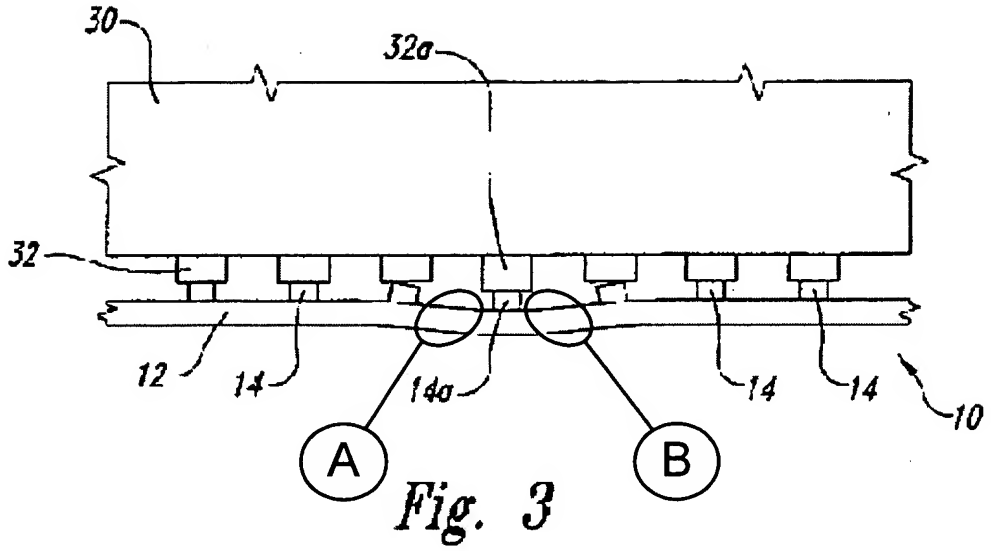

Fig. 3

Figure 3 shows a flexible connector 12 having contact pads 14 thereon in alignment with contact pads 32 of a circuit board 30, such that contact pads on each are brought into electrical connection. The figures and various features are greatly enlarged here for illustration purposes. Since the contacts are very small, even minor variations in the height of either will affect the contact performance. If one of the contact pads 32a of the circuit board 30 is slightly taller than those surrounding it, the contact pad 14a on the flexible connector contacts this high pad 32a first and pushes back on the flexible connector 12, such that contact pads adjacent to the contact pad 14a are unable to make firm contact with their corresponding contact pads of the circuit board 30. The substrate 12 in zones A and B becomes tight and pulls the adjacent pads out of alignment. With very tight tolerances and close spacing between pads, even a small difference in height can cause a problem. Such an occurrence can result in undependable connections, or undesirable resistance in the connections between those contact pads.

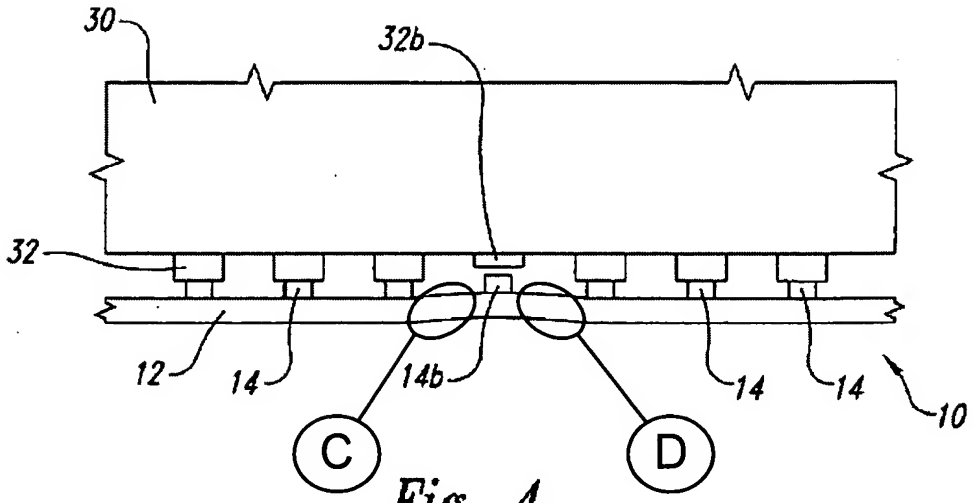

Fig. 4

Referring to Figure 4, it may be seen that the contact pad 32b of the circuit board 30 is slightly shorter than those contact pads 32 surrounding it. As a result, the flexible connector 12 bridges across that contact pad 32b, and the contact pad 14b of the flexible connector 12 is unable to make electrical contact with the contact pad 32b. The substrate 12, though usually flexible, has metal contacts adjacent to the short pad 32b so that it holds pad 14b back and prevents it from touching, even with high pressure applied. Consequently, no electrical connection is formed between the contact pad 14b of the flexible connector 12 and the contact pad 32b of the circuit board 30.

Failure of the connection of one or more contact pads, from among thousands of such connections in a complex system, may cause the entire system to shut down. Additionally, troubleshooting such a failure can be extremely difficult. Two approaches used in the prior art are: 1) make the contacts more exactly the same height; and 2) make both boards stiffer, so that all contacts can be pushed with greater force. The first solution , making more uniform contact heights, is workable, but can be very expensive since precise control of metal buildup during plating is difficult and tight tolerances are hard to achieve. The second solution, make both boards stiff, can only work if the contacts are all the same height, thus forcing the first solution to be solved also for tight packing density.

The inventors realized that one solution was more flexibility, not more uniform heights or less flexibility. By making one substrate more flexible, it could bend between contact pads to more easily conform to the circuit board variations from one contact pad to another.

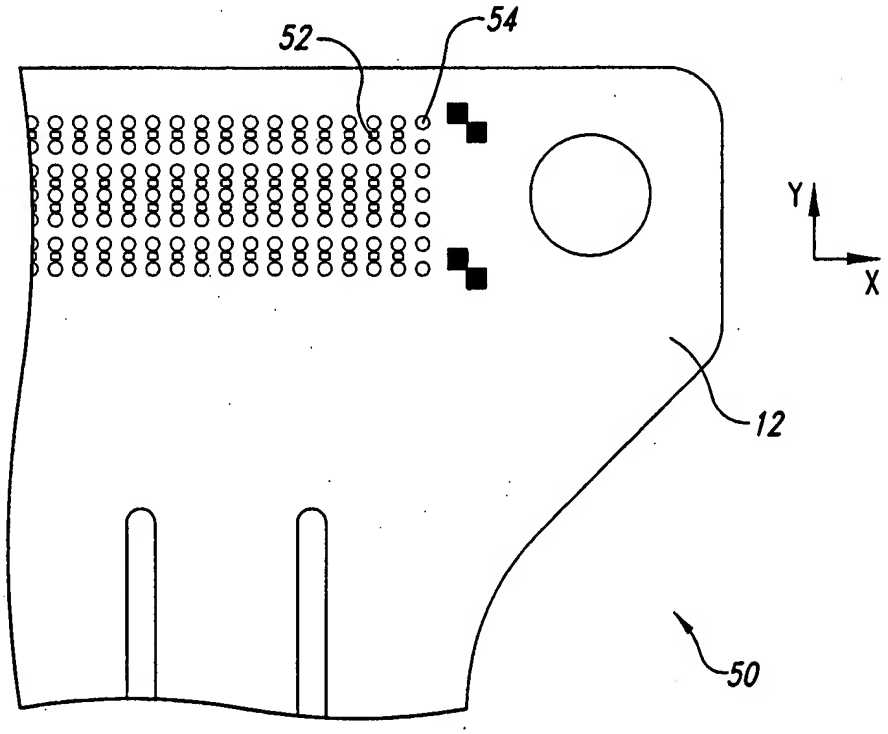

Fig. 5

Embodiments of the present invention are directed to structures and methods for locally increasing the flexibility of flexible connector sheet 12. According to the embodiment of Figure 5, the flexibility of the pad 12 is increased by providing strain relief structures 52 in the regions A and B, and C and D, to permit the substrate 12 to flex more at these locations. These strain relief structures 52 are selectively positioned between closely adjacent contact pads 54 to enhance the local flexibility of the connector 12 for the purpose of overcoming the problems described with reference to Figures 3 and 4.

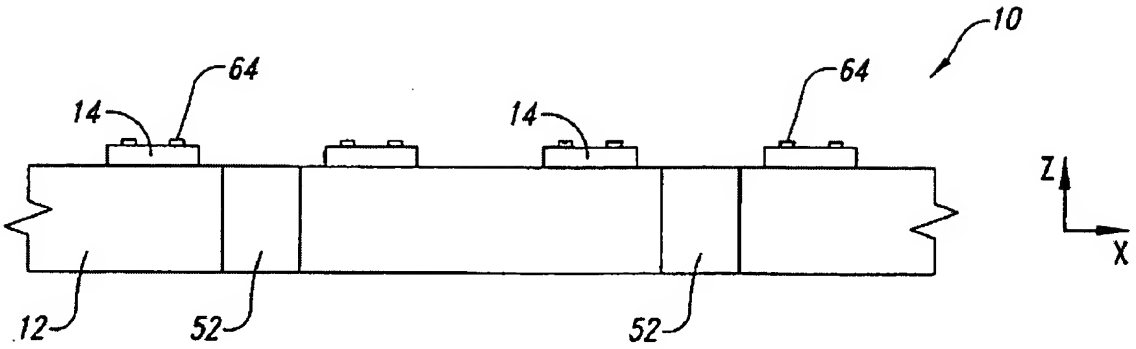

Fig. 7

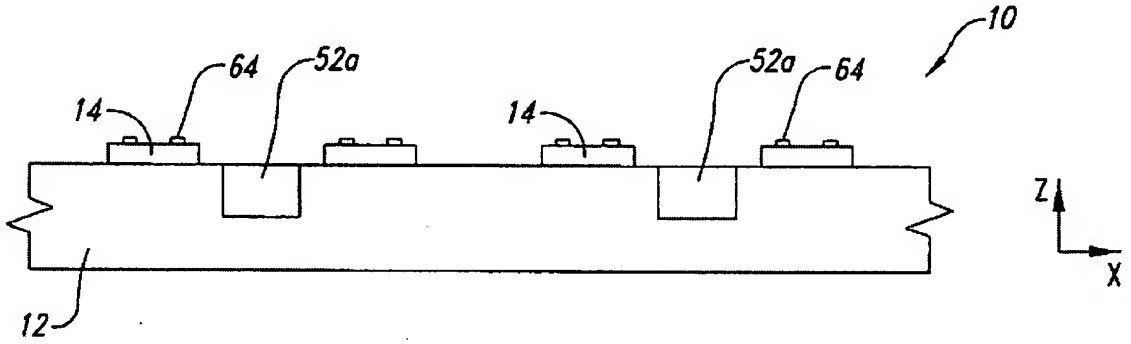

Fig. 8

Figure 7 illustrates a first embodiment, in which apertures 52 are formed traversing the entire thickness of the flexible connector 12. Figure 8 illustrates a second embodiment, in which blind apertures 52a are formed in the flexible substrate 12. The apertures 52a do not pass entirely through the thickness of the flexible substrate 12, but penetrate to a selected depth, the depth being selected according to the amount of added flexibility desired. Because there is less material, the connector 12 is more flexible adjacent to locations 52. It is counter-intuitive that forming apertures between the contact pads will improve the electrical connections, but that is the result of this invention.

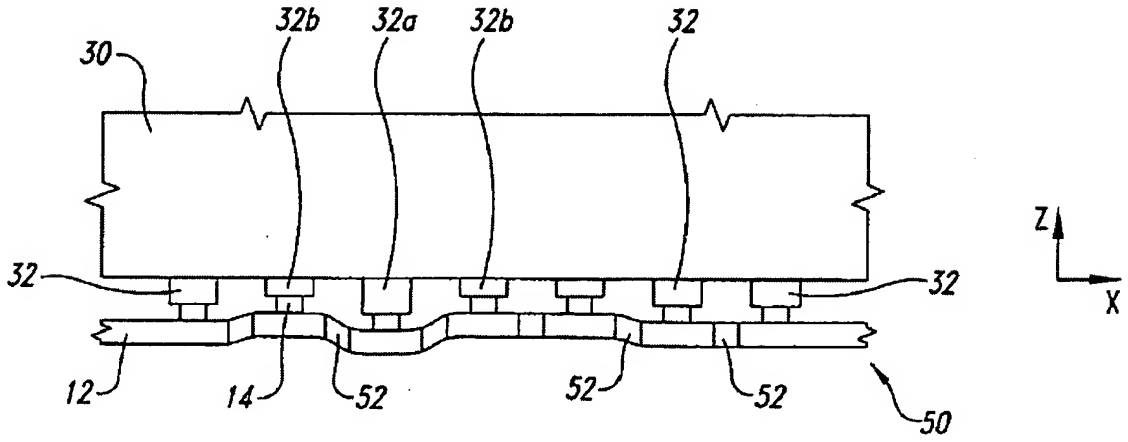

Fig. 9

Figure 9 illustrates a flexible connector 12 having contact pads 14 in contact with contact pads 32 of a circuit board 30, in which strain relief structures 52 provide localized strain relief, allowing the flexible connector 12 to accommodate variations in length of the contact pads 32a and 32b of the circuit board 30. Variations in size of the contact pads 14 of the flexible connector are also compensated for in a similar manner.

Not only do the strain relief structures of the various embodiments of the invention improve the dependability of the connections, but, because they allow the flexible connector to tolerate variations in contact heights, manufacturing tolerances can be relaxed, with respect to planarity of contact surfaces on both the connector and the circuit board. This means that fewer parts are rejected, and production costs are reduced.

VI. ISSUES

1. Whether claims 14-17 should be rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention.

2. Whether claims 1, 2, 4, and 6-8 should be rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,428,190 to Stopperan.

3. Whether claims 3 and 5 should be rejected under 35 U.S.C. § 103(a) as being unpatentable over Stopperan in view of U.S. Patent No. 3,977,074 to Furnival.

4. Whether claims 9-17 should be rejected under 35 U.S.C. § 103(a) as being unpatentable over the admitted prior art in view of Furnival.

VII. GROUPING OF CLAIMS

The rejected claims do not all stand or fall together. Claim 1 is an independent claim that is patentable over the prior art. Claims 2 and 7 stand or fall together with claim 1. Claims 3-6, and 8 are each independently patentable for reasons beyond the patentability of claim 1. Claim 9 is an independent claim that is patentable over the prior art. Claim 10 is an independent claim that is patentable over the prior art. Claim 13 stands or falls with claim 10. Claims 11 and 12 are each independently patentable for reasons beyond the patentability of claim 10. Claim 14 is an independent claim that is patentable over the prior art. Claims 15, 16, and 17 are each independently patentable for reasons beyond the patentability of claim 14.

VIII. ARGUMENT: ART OF RECORD DOES NOT ESTABLISH *PRIMA FACIE* CASE OF UNPATENTABILITY

Rejections Under 35 U.S.C. § 112:

Claims 14-17 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter that is not appropriately disclosed in the specification. In rejecting these claims, the Examiner states, "the specification...(is) silent regarding 'means for increasing flexibility of the substrate,' claim 14, line 5."

The Examiner clarifies his position with respect to this rejection in his response to arguments on page 5, last paragraph, stating, "applicant explains in page 7 of the amendment filed on 04/02/03 that the 'means for function which is means to increase the flexible connector' by using different material, thinning the material, or removing the material that does not make any senses, since Examiner had a question that what thing/element cause the 'means for'

function to be increase flexibility of the substrate. Nowhere in the specification teaches/describes the function of 'means for increase the flexibility of the substrate' [*sic*]."

Applicants find the Examiner's statement confusing due, first, to significant grammatical inconsistencies, second, to inaccurate quotation of applicants' remarks, and third, to an apparent failure on the part of the Examiner to recognize, or understand the proper use of the term of art, "means for," in a means-plus-function claim, as detailed in 35 U.S.C. § 112, sixth paragraph.

To the best of the applicants' understanding, the rejection seems to be based upon the Examiner's inability to find any reference in the specification that includes the actual words "means for." Thus, the Examiner has rejected the claims as being unsupported by appropriate language in the specification.

MPEP § 2181 states the following:

> A claim limitation will be interpreted to invoke 35 U.S.C. 112, sixth paragraph if it meets the following 3-prong analysis:
>
> (A) the claim limitations must use the phrase "means for" or "step for";
>
> (B) the "means for" ... must be modified by functional language; and
>
> (C) the phrase "means for" ... must not be modified by sufficient structure, material or acts for achieving the specified function.

The relevant limitation of claim 14 recites "means for increasing flexibility of the substrate in the contact region." Clearly, this limitation meets the three-pronged analysis set forth in the MPEP. Namely, (A) the phrase "means for" is used, (B) modified by functional language, and (C) without additional structure, material or acts for achieving the function. Accordingly, the phrase "means for" is used appropriately, and so, in itself, does not give rise to a rejection under § 112, second paragraph.

With respect to the other question raised by this rejection, namely, does the specification provide adequate support for the "means for increasing flexibility..." limitation of claim 14, applicants fully addressed this question in applicants' response to the Office Action of January 2, 2003, and also addresses it here.

Support in the original specification for the recitation of claim 14, of a "means for increasing flexibility of the substrate," is found throughout the specification and in the original

claims. Since it is so frequently discussed in the original claims and specification, applicants will point to only one clear quote from the specification, on page 6, beginning at line 4, which reads:

> according to the principles of the invention, a flexible connector is provided having a flexibility that varies over the surface of the substrate. It has greater flexibility in a localized region surrounding contact pads and greater stiffness over the rest of the connector. The greater flexibility may be provided by variations in substrate materials of the connector, or by thinning or removing selected amounts of the substrate of the connector in that region.

It is thus clear that the specification provides a description of at least three means to increase the flexibility of the connector: using different materials, thinning the material or removing the material.

Conclusion of Rejections under 35 U.S.C. § 112

The Examiner has erred in his understanding of 35 U.S.C. § 112, paragraph 6, and in his assertion that claim 14 is not supported by the specification.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, 4, and 6-8 were rejected under 35 U.S.C. § 102(b) as being anticipated by Stopperan (U.S. Patent No. 5,428,190).

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an ipsissimis verbis test, *i.e.*, identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990).

The Examiner has failed to present a *prima facie* case of anticipation of claims 1, 4, and 6-8. The Examiner erred in asserting that Stopperan teaches or enables each of the claimed elements, either expressly or inherently, of the invention as interpreted by one of ordinary skill in

the art. In particular, Stopperan fails to teach "a strain relief structure, positioned between two of the plurality of contact pads," as recited in claim 1, as will now be shown.

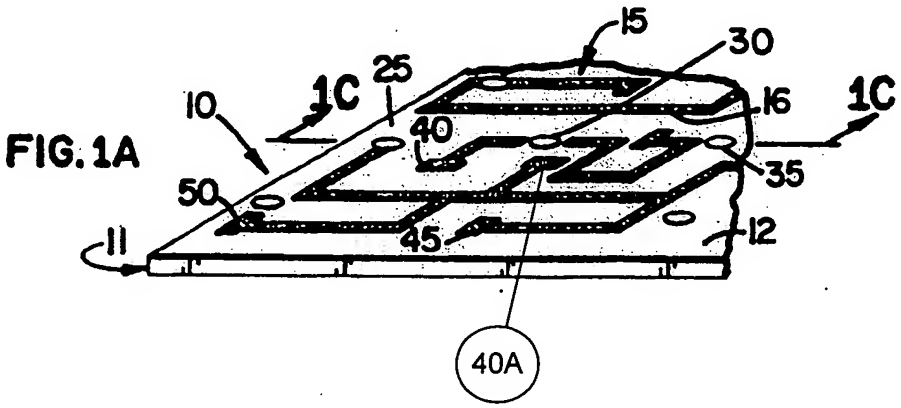

FIG. 1A

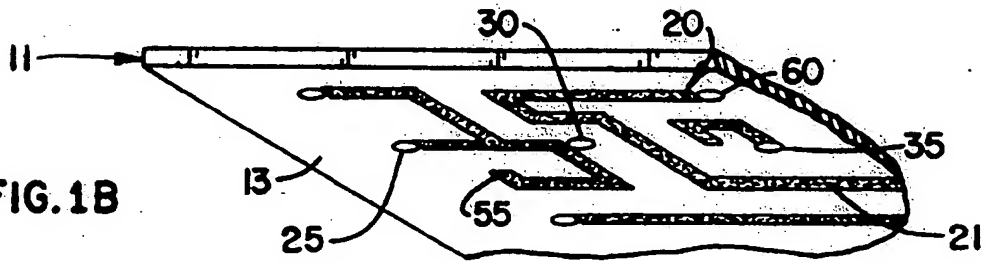

FIG. 1B

Stopperan discloses, as shown in Figures 1A-1C, and as discussed at column 8, lines 24-30, plated through holes (PTH) 25, 30, 35, configured to provide electrical connection between layers of the substrate 11. The Examiner has cited the plated through holes as being analogous to the strain relief structure of claim 1. In Stopperan, the contact pads are elements 40, 45, 50, 55, and 60 (see column 8, lines 7-8, lines 15, 16, and Figures 1A and 1B).

There are no apertures or strain relief structures of any type in-between these contact pads. One particular pair of contact pads are pads 40 and an unnumbered adjacent pad, which applicants have labelled 40A for reference in this appeal brief. These are two pads next to each other, yet there is no aperture or other strain relief structure between them.

Looking at the two numbered contact pads 45 and 50 from Stopperan, Figure 1A, again, there is no strain relief structure between them. It appears that the plated through holes 25, 30, 35 are placed in the circuit board according to the electrical connection to be provided and the

need to connect certain lines, not based on the ability to provide strain relief between contact pads. There are, in fact, no apertures in Stopperan positioned between any two contact pads. He just plain fails to show this claimed feature.

A second shortcoming of Stopperan is that the holes he provides are not strain relief structures, these are stiffening structures. The holes are plated with rigid metal, that makes them less flexible, not more flexible. Apparently, the Examiner has assumed that any aperture that passes through a substrate qualifies as a strain relief structure (note that claim 2 recites the limitation wherein the strain relief structure is an aperture penetrating through the flexible substrate). However, as explained in the summary of the invention above, the flexibility of a substrate is reduced by the portions of surface area occupied by inflexible metal structures.

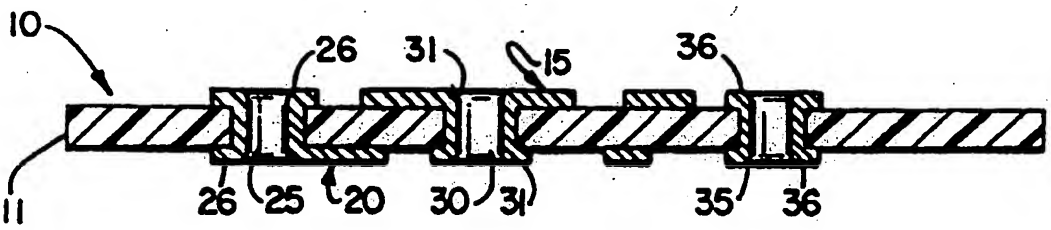

FIG. 1C

Clearly, the PTH structures, described with reference to Stopperan's Figure 1C, fall into the category of inflexible metal structures. Structures such as these will inherently reduce flexibility of the substrate upon which they are formed, due to the additional metal deposited on the surfaces of the substrate, as well as the metal barrel lining the holes. Thus, they cannot be regarded as providing strain relief, but, on the contrary, will tend to increase stiffness, and will localize strain at the edges of the metal surfaces during flexing of the substrate.

Stopperan offers no teaching to the contrary, stating only "if the thickness of the substrate 11 used is relatively thin ... the length of the copper barrels is therefore also only a few mils (the total thickness of substrate 11 and conductive layers 15 and 20), and thermal mechanical stress is never a problem ..." (column 8, line 65 through column 9, line 1). Stopperan does not regard the plated through holes of Figures 1A-1C as strain relief structures, but rather, considers it important that the substrate used be "relatively thin," so that a problem is not created, due to the

length of the copper barrels. This is not how one would describe a strain relief structure. Consequently, the Examiner was incorrect in citing the plated through holes as being equivalent to the strain relief structure of claim 1.

Claim 4 recites the strain relief structure as being "a thinned region of the flexible substrate." In rejecting claim 4, the Examiner did not cite a specific structure of Stopperan as being equivalent to the thinned region of claim 4, but rather cited column 7, lines 67 and 68 of Stopperan. The cited text reads, "typical thickness of an insulating substrate can be from about 12.5 to 125 microns for the flexible board and about 200 microns to 2400 microns." While the cited text does discuss ranges of thicknesses appropriate for the various substrates, there is no mention of a particular region of the flexible substrate that is thinned, nor is there a discussion of the relationship of such a region with respect to the location of the contact pads. Accordingly, the Examiner's rejection of claim 4 is inappropriate.

Claim 6 states "wherein the strain relief structure is centered on a line between centers of two of the plurality of contact pads."

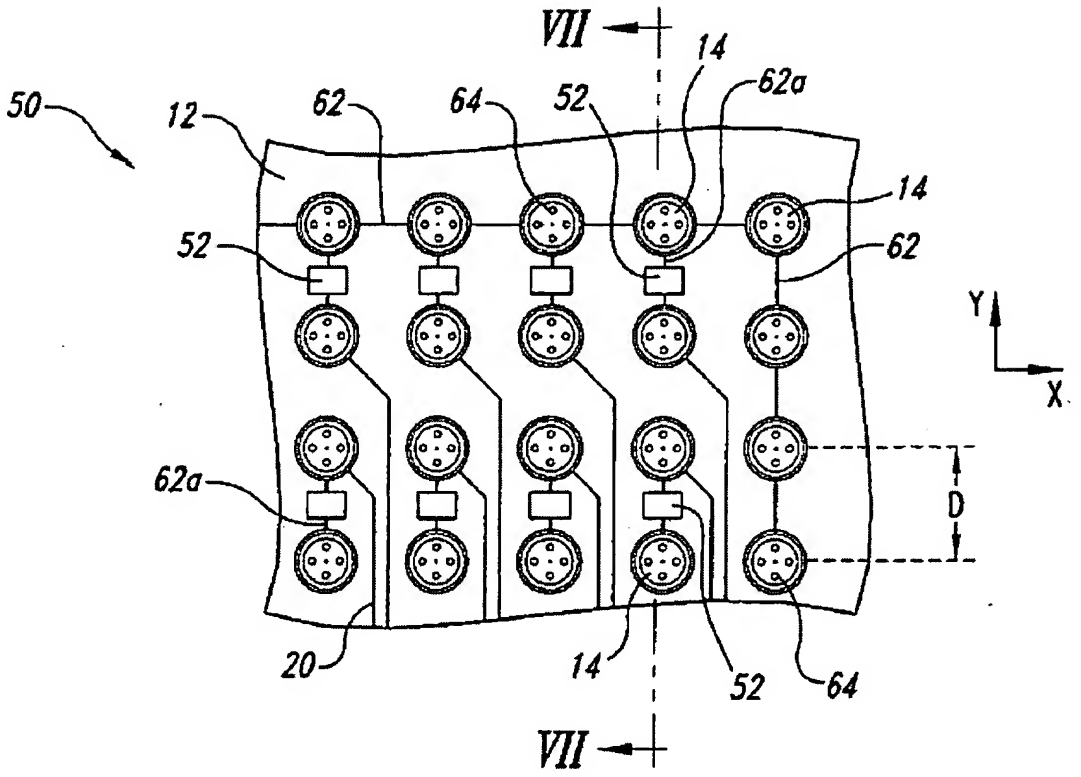

Fig. 6

Figure 6 of the present application, reproduced above, shows one of many embodiments upon which claim 6 reads. It may be seen that each of the strain relief structures 12 is positioned between two adjacent contact pads 54.

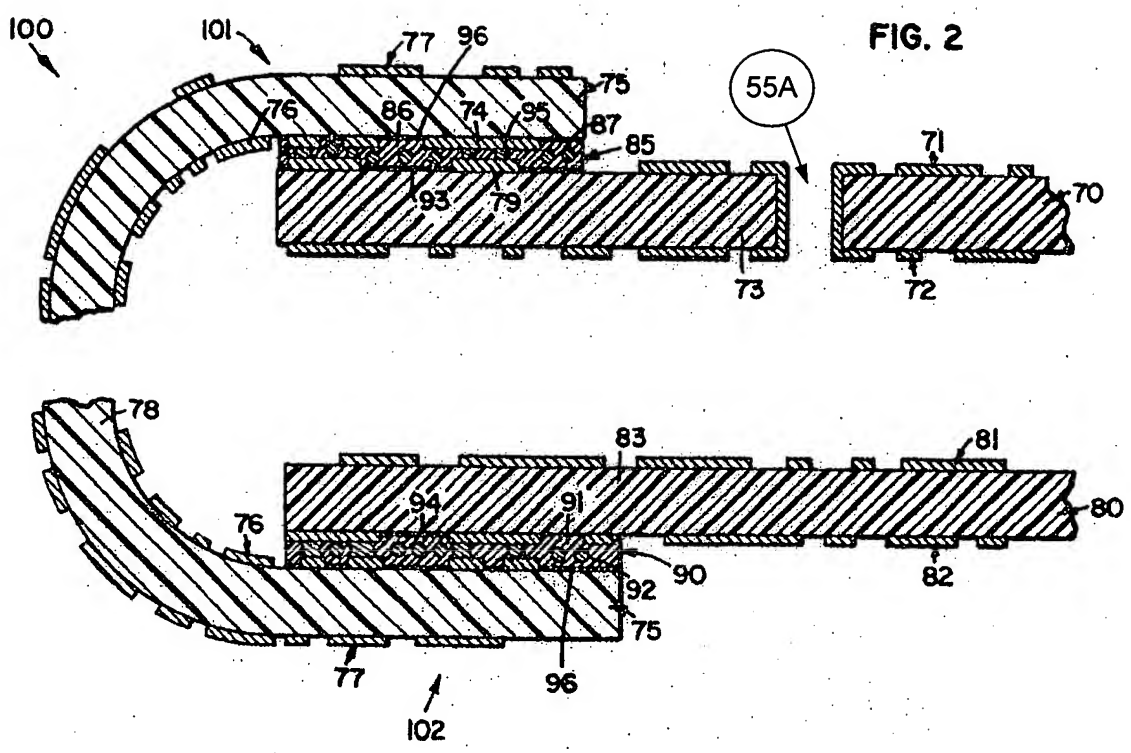

FIG. 2

The Examiner, in rejecting claim 6, cited Figure 2 of Stopperan as teaching the limitation thereof. This rejection is inappropriate. Referring to Stopperan's Figure 2, the only feature identified by Stopperan that may be remotely considered to be analogous to the contact pads of claim 1 (base claim to claim 6) is the interconnecting pad 74. Stopperan describes the interconnecting pad 74 as being configured to provide a connection between the circuits of flexible board 75 and those of rigid substrate 70 (see, for example, the description of Figure 2, and in particular column 15, lines 7-11, 29, 30). Even if we assume that there are more interconnecting pads than the single pad 74 identified on the flexible board 75, there are no structures identified in Figure 2 that may be considered analogous to strain relief structures, nor did the Examiner indicate any structures as being such.

The one aperture shown in Figure 2 of Stopperan is not numbered, in his figure, so applicants have added number 55A for reference in this appeal brief. Thus, even if 55A is considered a strain relief structure, which it is not, it is not between two contact pads.

Claim 8 recites "wherein the strain relief structure is positioned such that it interrupts one of the plurality of electrical traces." In rejecting claim 8, the Examiner again cites Figure 1 as teaching that limitation. Referring to Figure 1C of Stopperan, it may be seen that the plated through holes cited by the Examiner as being analogous to the strain relief structure do not interrupt the traces, but rather provide for their electrical continuity. Not only this, but they also provide electrical continuity with other layers of the substrate. Accordingly, the Examiner's rejection is in error.

Conclusion of Rejections Under 35 U.S.C. § 102

The Examiner has erred in asserting that Stopperan teaches each of the claimed limitations of claims 1, 2, 4, and 6-8 as interpreted by one of ordinary skill in the art. The Examiner has erred in asserting that the plated through holes of Stopperan are analogous to the strain relief structure of claim 1. The Examiner has erred in asserting that Stopperan teaches a strain relief structure comprising a thinned region of a flexible substrate. The Examiner has erred in asserting that Stopperan teaches a strain relief structure centered on a line between centers of two of a plurality of contact pads. The Examiner has erred in asserting that Stopperan teaches a strain relief structure positioned such that it interrupts one of a plurality of electrical traces. For at least these reasons, the Examiner has failed to present a *prima facie* case of anticipation of claims 1, 2, 4, and 6-8.

Rejections Under 35 U.S.C. § 103(a)

Claims 3 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,428,190 to Stopperan in view of U.S. Patent No. 3,977,074 to Furnival. Applicants believe the Examiner did not meet his burden to present a *prima facie* case of obviousness. In particular, the Examiner erred in combining Furnival with Stopperan. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings,

knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000).

Furnival does not show, and is not cited by the Examiner to show, the missing feature of a strain relief structure between contact pads. Furnival does not show contact pads or any apertures between them and thus does not teach this feature. Even if combined, Stopperan and Furnival fail to show the claimed invention.

The Examiner asserted that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a rectangular shape as taught by Furnival to employ the device of Stopperan in order to provide an interfacial connection which is inexpensive and more reliable." Thus, the Examiner asserts that the motivation to combine resides in an obvious understanding that the aperture of Stopperan would be less expensive and more reliable if made in the rectangular shape taught by Furnival.

This statement by the Examiner is incorrect. Stopperan teaches away from a combination with Furnival, inasmuch as the relevant portions of Stopperan are directed to a flexible interconnector, while Furnival is directed to a rigid circuit substrate. In response to this argument, when previously presented thereto, the Examiner stated, "Furnival teaches a printed circuit board made of dielectric materials disclosed in Figures 1-6, the dielectric material has properties as flexible as well [*sic*]." Apparently, the Examiner's point is that any circuit board has some degree of flexibility, and so may be regarded as falling within the scope of a claim reciting a flexible substrate.

While it may be true that there is virtually no substance on earth that can be considered to be absolutely rigid, or perfectly inflexible, one must consider the meaning of a term as understood by one having ordinary skill in the art. In the cases of Stopperan and Furnival, each reference provides an understanding of what is meant by the terms used. At column 4, lines 46-50, Stopperan states, "there is a need for a rigid-flex circuit board having at least one rigid board connected to at least one flexible interconnector that can be bent such that the rigid-flex board can be positioned to utilize space efficiently." One having ordinary skill in the art will understand the reference to a flexible connector in this statement as referring to a connector

having sufficient flexibility, for example, to connect between rigid circuit boards placed very closely together, and side by side within a computer. Stopperan's Figure 2 displays precisely this arrangement, in which rigid circuit boards 70 and 80 are connected together by flexible connector 75, which is shown doubled over on itself.

In contrast, Furnival teaches "a printed circuit substrate 10 preferably of the rigid variety ...." See column 2, lines 1, 2 of Furnival. Furnival itself teaches a flexible substrate 32 which bends to enter the aperture created by the punch-out of piercing tool 20. Thus even Furnival teaches that his substrate 10 is rigid, as compared to substrate 32, which is flexible. One having ordinary skill in the art will not interpret substrate 10 to be one of perfect rigidity, but rather to what is commonly known in the art as a rigid substrate, namely, a substrate that has a high degree of stiffness, and that can be used in an application where it must resist flexing, and remain substantially planar.

There can be no confusion as to the relative meaning of "flexible" vs. "rigid" in the context of Stopperan, Furnival or this invention. One of ordinary skill in the art would certainly not be motivated to combine a technology specifically designed for use with a flexible substrate, with an application requiring a substrate having a high degree of rigidity.

A combination of Furnival's interfacial connector with Stopperan's flexible jumper would render Stopperan unsatisfactory for its intended use.

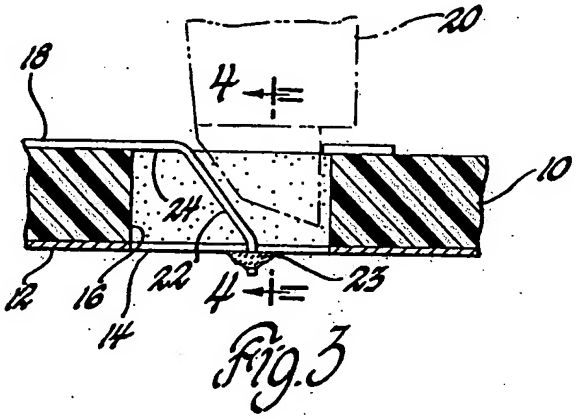

Fig.3

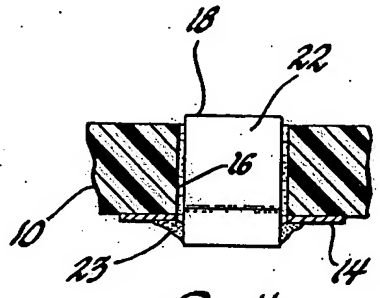

Fig.4

As shown in Furnival's Figure 3, Furnival is directed to a technology in which a hole is formed in a rigid substrate 10 having a conductive layer 12 on one surface. A second conductive

layer 18 is then applied to the opposite surface of the substrate 10, and a piercing tool 20 is employed to form a tab 22, which is forced through the hole and soldered on two edges to the conductive layer 12 on the opposite side. Viewing Furnival's Figures 3 and 4, it may be seen that the solder joint 23 is limited to a very short, narrow region on the edges of the tab 22. Accordingly, it would be obvious to one having ordinary skill in the art that such a connection would be inappropriate for use on a flexible connector, as the term is understood in the art, inasmuch as the extreme flexing of the connector would tend to break the solder joints 23. In particular, any twisting of the flexible substrate, as would be common in handling a flexible jumper such as Stopperan's, would almost certainly cause such a connection to fail. Thus, the proposed modification would render Stopperan unsatisfactory for its intended use.

If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

Claims 9-17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the prior art Figures 1 and 2, submitted by the applicants, in view of U.S. Patent No. 3,977,074 to Furnival. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970). If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

The Examiner has again failed to meet his burden to present a *prima facie* case of obviousness. The Examiner failed to show that the admitted prior art, Furnival, or a combination, teach or suggest all the claim limitations of independent claim 9, which recites "a plurality of apertures arranged in a regular configuration and intercalated into the plurality of contact pads." Claim 9 is particularly clear in the requirement for the apertures being "intercalated into the plurality of contact pads." This refers to the apertures being positioned in a regular pattern in-between adjacent contact pads. Certainly, this feature is not found in the

combination of Stopperan and Furnival. Neither Stopperan nor Furnival teach such features, even if the full teachings of both were combined.

Of course, the present application shows contact pads that are adjacent to each other. However, Furnival does not teach or suggest that an aperture, or any other structure to make the contact pads more flexible is to be positioned between the contact pads. Furnival is utterly missing in any suggestion to add an aperture at such a location.

The admitted prior art of the present application offers no suggestion as to how the problems outlined should be resolved, and certainly does not offer any suggestion as to the arrangement of strain relief structures. Meanwhile, Furnival does not offer any teaching with respect to a flexible connector, does not disclose contact pads of any sort, does not teach that apertures should be arranged in any particular arrangement or configuration, and does not suggest that such apertures would be of any use in increasing flexibility of a flexible substrate. Accordingly, the combination of the admitted prior art with Furnival fails to teach all the claim limitations of claim 9.

The rejection of claims 9-17 under § 103 of applicants' admitted prior art and Furnival must fail for additional reasons as will now be explained.

Figures 1 and 2 of the present application are directed to a flexible connector and the contact pads thereon. In contrast, as previously demonstrated, Furnival is directed to a rigid circuit board, and is not compatible with a flexible connector.

In addition, Furnival is further directed to structures configured to interconnect opposing surfaces thereof. The admitted prior art in the present application makes no reference to interconnection of opposing surfaces of the connector, while for his part, Furnival is silent on the question of connectors, contact pads, means, or motives for increasing flexibility of a substrate. Thus, in the first place, Furnival's fragile solder joints are not compatible with the flexible connector of the admitted prior art, and, in the second place, there is no common teaching or motivation to combine. Accordingly, the Examiner erred in combining Furnival with the admitted prior art.

Claim 10 of the present invention specifically calls for "forming between two of the plurality of contact pads, a strain relief structure. Certainly, Furnival does not teach that a strain

relief structure is to be formed between two contact pads. Of course, the admitted prior art is a plurality of contact pads on a flexible substrate; this has been well known in the art for many years. What has not been known, and what Furnival fails to show is that the reliability of the electrical connection can be increased by placing a strain relief structure, such as an aperture, in-between two contact pads. Furnival does not teach or suggest this particular feature and therefore, even if the two prior art references are combined, this claim feature is completely missing from such a combination. Further, as previously explained with respect to claim 9, there is no teaching to combine the references. All the reasons for the failure to teach a combination are not repeated here since they are made with respect to claim 9 and apply in the same regard for claim 10.

The Examiner failed to show that the admitted prior art in combination with Furnival teaches or suggests all the claim limitations of claim 14, which recites, *inter alia* "means for increasing flexibility of the substrate in the contact region." As previously demonstrated above in the argument for claim 9, the Examiner has failed to present a *prima facie* case of the obviousness of claim 14 over the admitted prior art in view of Furnival. In addition, Furnival is silent with respect to means for increasing flexibility of a substrate. Inasmuch as Furnival is directed to a structure for connecting conductive layers positioned on opposite sides of a rigid circuit board, and inasmuch as Furnival specifies that the board should preferably be rigid, it is clear that Furnival does not contemplate his disclosed invention being used for purposes of increasing flexibility.

The Examiner has erred in rejecting claim 15 over the admitted prior art in view of Furnival. Claim 15 recites a means for increasing flexibility comprising a plurality of apertures intercalated with the plurality of contact pads. There is no teaching or suggestion in either the admitted prior art or Furnival offering any direction with respect to the location of apertures relative to contact pads.

The Examiner has erred in rejecting claim 16 as being obvious over the admitted prior art, in combination with Furnival. Claim 16 recites a means for increasing flexibility comprising a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from a first surface to a selected depth. In addition to the previously presented

arguments with respect to the combination of the admitted prior art with Furnival, and with respect to the lack of teachings with respect to the location of the apertures, Furnival teaches only apertures penetrating completely through the rigid substrate. Nor is there any suggestion that apertures penetrating a selected depth might be employed, inasmuch as Furnival's structure requires complete penetration of the substrate for proper operation. Accordingly, the rejection of claim 16 is inappropriate.

The Examiner's rejection of claim 17 under 35 U.S.C. § 103(a) as being unpatentable over the admitted prior art in view of Furnival, is inappropriate. Claim 17 recites a means for increasing flexibility comprising a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region. The Examiner has failed to cite any specific structure or passage of Furnival that teaches or suggests a thinning of the substrate for any reason, let alone for increased flexibility. Furthermore, Furnival teaches a substrate that is preferably rigidly, thus teaching away from increased flexibility. For its part, the acknowledged prior art also fails to provide such a teaching. Accordingly, the rejection is inappropriate.

Conclusion of Rejections Under 35 U.S.C. § 103

Applicants believe that the Examiner has not met his burden of presenting a *prima facie* case of obviousness. The references have been inappropriately combined, and furthermore, the prior art of record does not teach each limitation of the present invention, nor does it suggest the limitations of the present invention. Therefore, applicants respectfully request consideration of allowance of the claims.

In conclusion, applicants believe that all claims are allowable in light of the prior and that a Notice of Allowance should be issued.

IX. CONCLUSION

In summary, applicants believe that the claims of the present invention are patentable, and not obvious in light of the combination of the cited references made by the Examiner. Allowance of the claims is respectfully requested.

Respectfully submitted,

Seed Intellectual Property Law Group PLLC

Harold H. Bennett II
Registration No. 52,404

HHB:jl

Enclosures:

Amendment After Final
1 Sheet of Replacement Drawings, Figures 5-6

701 Fifth Avenue, Suite 6300
Seattle, Washington 98104-7092
Phone: (206) 622-4900
Fax: (206) 682-6031

901115.435 \ 430213_1.DOC

APPENDIX A

X. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

1. (Original) A device, comprising:

a flexible substrate;

a plurality of contact pads on a first surface of the substrate; and

a strain relief structure, positioned between two of the plurality of contact pads.

2. (Original) The device of claim 1 wherein the strain relief structure is an aperture, penetrating through the flexible substrate from the first surface to a second surface.

3. (Original) The device of claim 2 wherein the aperture has, in plan view, a rectangular shape.

4. (Original) The device of claim 1, wherein the strain relief structure is a thinned region of the flexible substrate.

5. (Original) The device of claim 4, wherein the thinned region has, in plan view, a rectangular shape.

6. (Original) The device of claim 1, wherein the strain relief structure is centered on a line between centers of two of the plurality of contact pads.

7. (Original) The device of claim 1, further comprising a plurality of electrical traces, each of the plurality of electrical traces being in electrical contact with one of the plurality of contact pads.

8. (Original) The device of claim 7, wherein the strain relief structure is positioned such that it interrupts one of the plurality of electrical traces.

9. (Original) An electrical connector, comprising:

a flexible substrate;

a plurality of contact pads arranged in a regular configuration on a first surface of the substrate;

a plurality of electrical traces on the flexible substrate, each of the plurality of electrical traces being in electrical contact with a respective one of the plurality of contact pads; and

a plurality of apertures penetrating through the flexible substrate, the plurality of apertures arranged in a regular configuration and intercalated into the plurality of contact pads.

10. (Previously Presented) A method of manufacturing a flexible connector, comprising:

forming, on a first surface of a flexible substrate, a plurality of contact pads;

forming, on the flexible substrate, a plurality of electrical traces, each of the plurality of electrical traces being in contact with one of the plurality of contact pads; and

forming, between two of the plurality of contact pads, a strain relief structure.

11. (Original) The method of claim 10, further including breaking one of the electrical traces with the forming the strain relief structure step.

12. (Original) The method of claim 10 wherein the strain relief structure is an aperture penetrating the flexible substrate from the first surface to a second surface.

13. (Original) The method of claim 10, wherein each of the plurality of electrical traces is formed on either the first surface of the flexible substrate, a second surface of the substrate or an inner layer of the substrate.

14. (Previously Presented) A flexible connector, comprising:

a flexible substrate;

a plurality of contact pads formed on a first surface of the substrate and arranged in a regular configuration in a contact region of the substrate; and

means for increasing flexibility of the substrate in the contact region.

15. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to a second surface, opposite the first.

16. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to selected depth.

17. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region.

EXPRESS MAIL NO. EV447224660 US

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Stephen V.R. Hellriegel et al.
Application No.	:	10/012,210
Filed	:	November 5, 2001
For	:	ELECTRICAL CONNECTOR WITH STRAIN RELIEF STRUCTURE

Examiner	:	Tuan T. Dinh
Art Unit	:	2827
Docket No.	:	901115.435
Date	:	February 17, 2004

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' BRIEF (37 C.F.R. § 1.192)

Dear Sirs:

This brief is in furtherance of the Notice of Appeal, filed in this case on October 16, 2003. The fees required under Section 1.17(c) are enclosed with the accompanying fee transmittal. Applicants hereby request any extension of time necessary for acceptance of this Appeal Brief, and any other fees which may become due, and authorize said fees be charged to Deposit Account No. 19-1090.

I. REAL PARTY IN INTEREST

The real party in interest is Cray, Inc., which is the current name of the assignee of the present invention.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which directly effect or will be directly effected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-17 are currently pending and active in the application. Of these claims, claims 14-17 are rejected under 35 U.S.C. § 112, first paragraph as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Claims 1, 2, 4, and 6-8 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Stopperan. Claims 3 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Stopperan in view of Furnival. Claims 9-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over admitted prior art (Figures 1 and 2 of the present application) in view of Furnival. The current active claims are attached as Appendix A.

IV. STATUS OF AMENDMENTS

The Final Rejection was mailed July 16, 2003. In response to this Final Rejection, a Notice of Appeal was filed on October 16, 2003. No amendments after final have previously been filed. An amendment to correct a typographical error in Figure 5 is submitted herewith, and its entry is requested. The claims now pending in the application were those filed in the Amendment dated April 2, 2003.

V. SUMMARY OF INVENTION

One type of connector used in high performance computers is a flexible substrate having a plurality of small metal contact pads on the surface. The flexible substrate is aligned with corresponding contact pads on a circuit board and a controlled pressure is applied to bring the contact pads of the substrate into firm electrical contact with those of the circuit board. Connectors of this type often have contact densities exceeding 300 or 400 contacts per square inch. As contact densities increase on such connectors an ever larger percentage of the surface area of the flexible substrate is occupied by metal contact pads. As density increases, the flexibility of the substrate is reduced by the higher and higher percentage of surface area that is occupied by the inflexible metal structures of the contact pads. At the same time, the distance between contacts becomes smaller.

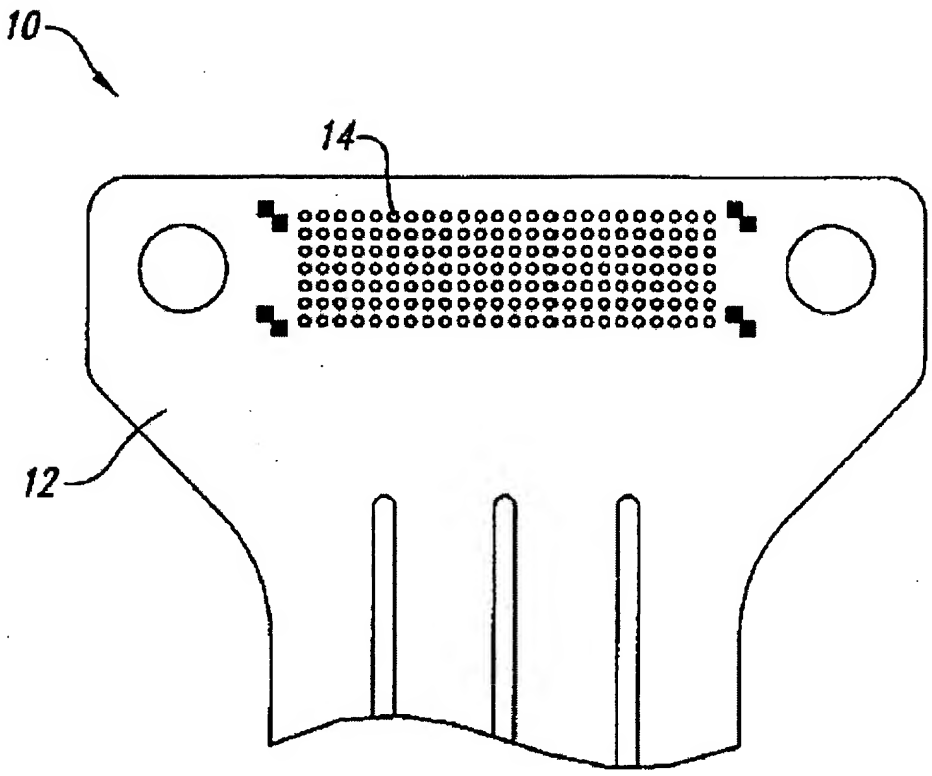

Fig. 1

Figure 1 illustrates a connector of the type described, on which the contact pads are arranged with a density of about 400 pads per square inch. Figures 3 and 4 illustrate some of the difficulties that can occur when using high density connectors such as that illustrated in Figure 1.

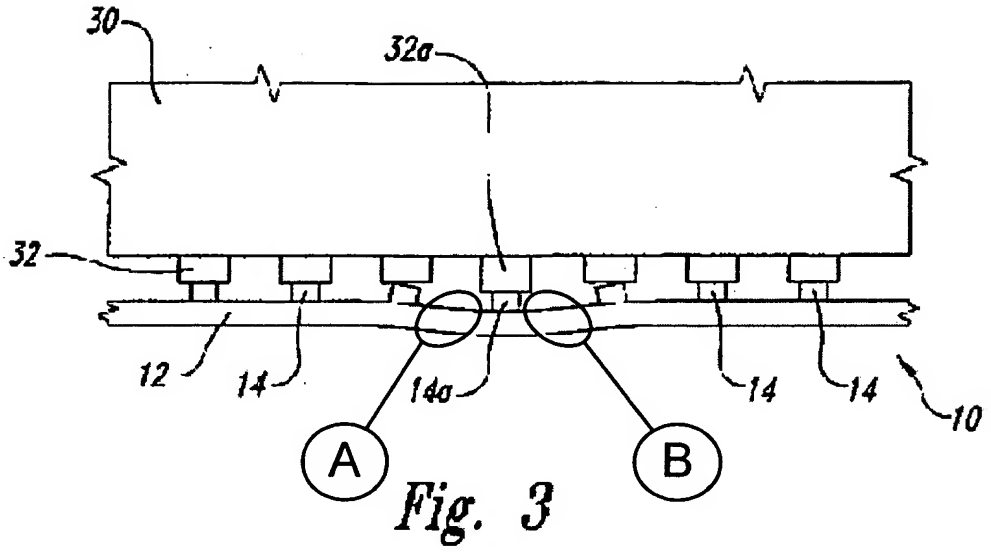

Fig. 3

Figure 3 shows a flexible connector 12 having contact pads 14 thereon in alignment with contact pads 32 of a circuit board 30, such that contact pads on each are brought into electrical connection. The figures and various features are greatly enlarged here for illustration purposes. Since the contacts are very small, even minor variations in the height of either will affect the contact performance. If one of the contact pads 32a of the circuit board 30 is slightly taller than those surrounding it, the contact pad 14a on the flexible connector contacts this high pad 32a first and pushes back on the flexible connector 12, such that contact pads adjacent to the contact pad 14a are unable to make firm contact with their corresponding contact pads of the circuit board 30. The substrate 12 in zones A and B becomes tight and pulls the adjacent pads out of alignment. With very tight tolerances and close spacing between pads, even a small difference in height can cause a problem. Such an occurrence can result in undependable connections, or undesirable resistance in the connections between those contact pads.

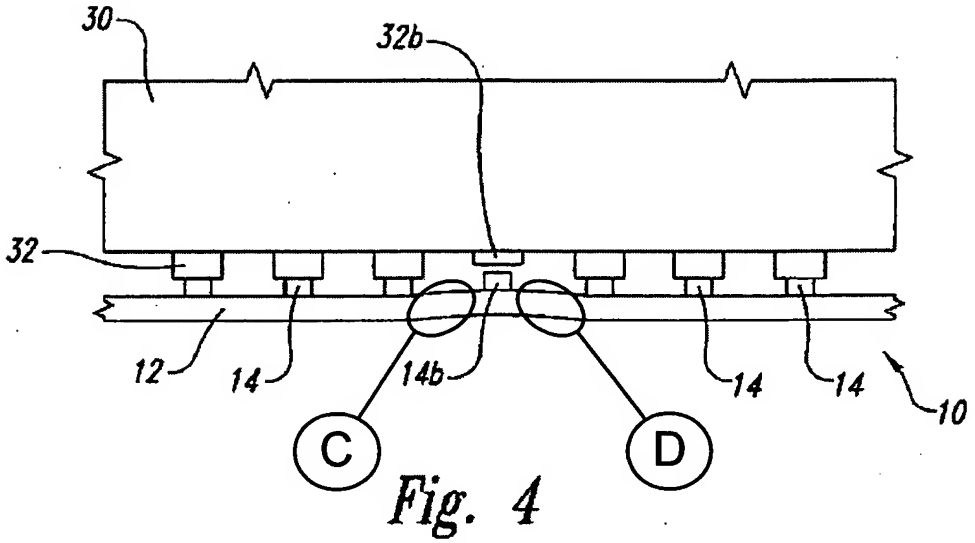

Fig. 4

Referring to Figure 4, it may be seen that the contact pad 32b of the circuit board 30 is slightly shorter than those contact pads 32 surrounding it. As a result, the flexible connector 12 bridges across that contact pad 32b, and the contact pad 14b of the flexible connector 12 is unable to make electrical contact with the contact pad 32b. The substrate 12, though usually flexible, has metal contacts adjacent to the short pad 32b so that it holds pad 14b back and prevents it from touching, even with high pressure applied. Consequently, no electrical connection is formed between the contact pad 14b of the flexible connector 12 and the contact pad 32b of the circuit board 30.

Failure of the connection of one or more contact pads, from among thousands of such connections in a complex system, may cause the entire system to shut down. Additionally, troubleshooting such a failure can be extremely difficult. Two approaches used in the prior art are: 1) make the contacts more exactly the same height; and 2) make both boards stiffer, so that all contacts can be pushed with greater force. The first solution , making more uniform contact heights, is workable, but can be very expensive since precise control of metal buildup during plating is difficult and tight tolerances are hard to achieve. The second solution, make both boards stiff, can only work if the contacts are all the same height, thus forcing the first solution to be solved also for tight packing density.

The inventors realized that one solution was more flexibility, not more uniform heights or less flexibility. By making one substrate more flexible, it could bend between contact pads to more easily conform to the circuit board variations from one contact pad to another.

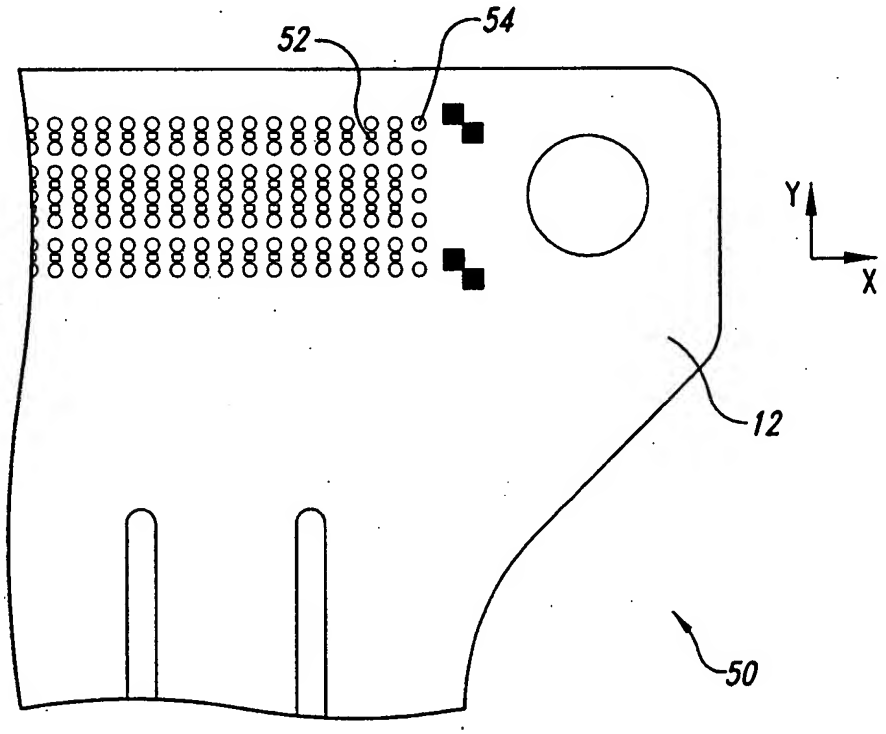

Fig. 5

Embodiments of the present invention are directed to structures and methods for locally increasing the flexibility of flexible connector sheet 12. According to the embodiment of Figure 5, the flexibility of the pad 12 is increased by providing strain relief structures 52 in the regions A and B, and C and D, to permit the substrate 12 to flex more at these locations. These strain relief structures 52 are selectively positioned between closely adjacent contact pads 54 to enhance the local flexibility of the connector 12 for the purpose of overcoming the problems described with reference to Figures 3 and 4.

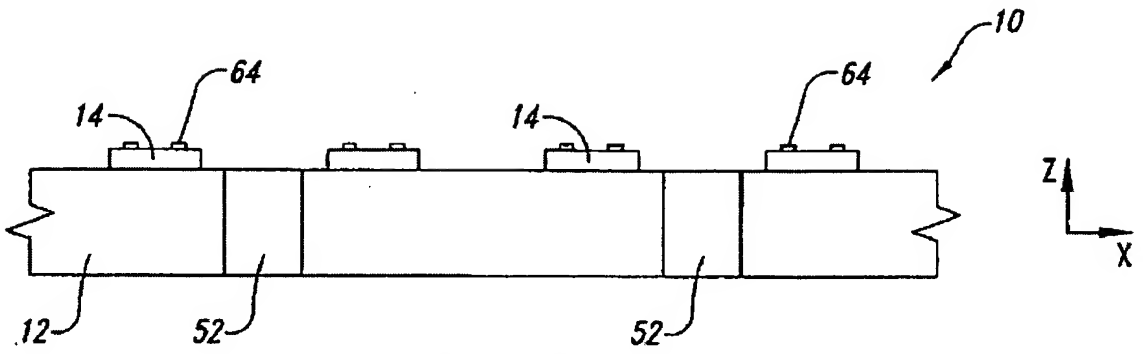

Fig. 7

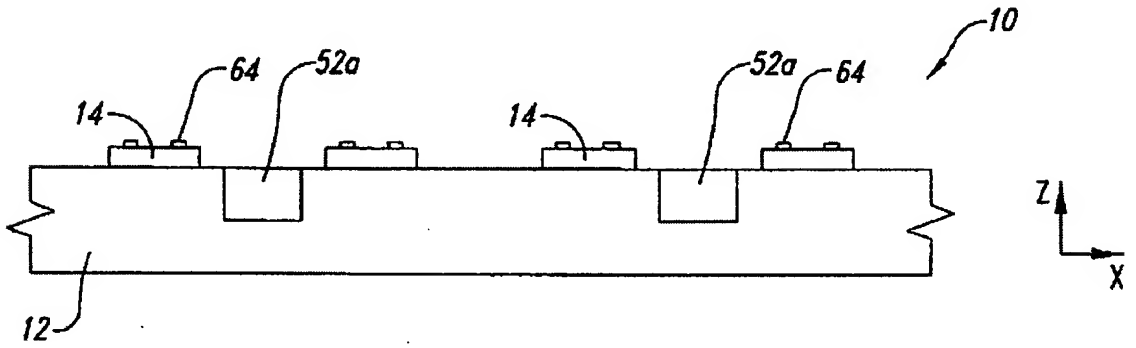

Fig. 8

Figure 7 illustrates a first embodiment, in which apertures 52 are formed traversing the entire thickness of the flexible connector 12. Figure 8 illustrates a second embodiment, in which blind apertures 52a are formed in the flexible substrate 12. The apertures 52a do not pass entirely through the thickness of the flexible substrate 12, but penetrate to a selected depth, the depth being selected according to the amount of added flexibility desired. Because there is less material, the connector 12 is more flexible adjacent to locations 52. It is counter-intuitive that forming apertures between the contact pads will improve the electrical connections, but that is the result of this invention.

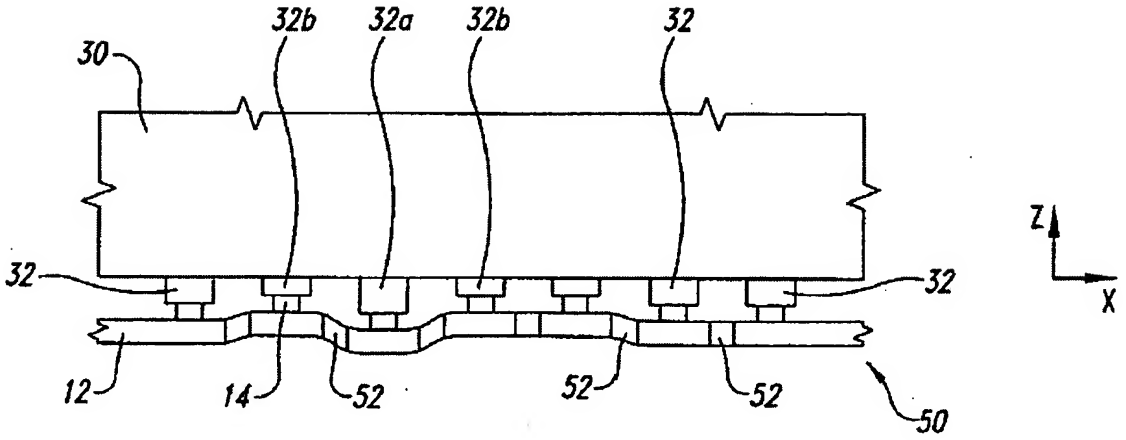

Fig. 9

Figure 9 illustrates a flexible connector 12 having contact pads 14 in contact with contact pads 32 of a circuit board 30, in which strain relief structures 52 provide localized strain relief, allowing the flexible connector 12 to accommodate variations in length of the contact pads 32a and 32b of the circuit board 30. Variations in size of the contact pads 14 of the flexible connector are also compensated for in a similar manner.

Not only do the strain relief structures of the various embodiments of the invention improve the dependability of the connections, but, because they allow the flexible connector to tolerate variations in contact heights, manufacturing tolerances can be relaxed, with respect to planarity of contact surfaces on both the connector and the circuit board. This means that fewer parts are rejected, and production costs are reduced.

VI. ISSUES

1. Whether claims 14-17 should be rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention.

2. Whether claims 1, 2, 4, and 6-8 should be rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,428,190 to Stopperan.

3. Whether claims 3 and 5 should be rejected under 35 U.S.C. § 103(a) as being unpatentable over Stopperan in view of U.S. Patent No. 3,977,074 to Furnival.

4. Whether claims 9-17 should be rejected under 35 U.S.C. § 103(a) as being unpatentable over the admitted prior art in view of Furnival.

VII. GROUPING OF CLAIMS

The rejected claims do not all stand or fall together. Claim 1 is an independent claim that is patentable over the prior art. Claims 2 and 7 stand or fall together with claim 1. Claims 3-6, and 8 are each independently patentable for reasons beyond the patentability of claim 1. Claim 9 is an independent claim that is patentable over the prior art. Claim 10 is an independent claim that is patentable over the prior art. Claim 13 stands or falls with claim 10. Claims 11 and 12 are each independently patentable for reasons beyond the patentability of claim 10. Claim 14 is an independent claim that is patentable over the prior art. Claims 15, 16, and 17 are each independently patentable for reasons beyond the patentability of claim 14.

VIII. ARGUMENT: ART OF RECORD DOES NOT ESTABLISH *PRIMA FACIE* CASE OF UNPATENTABILITY

Rejections Under 35 U.S.C. § 112:

Claims 14-17 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter that is not appropriately disclosed in the specification. In rejecting these claims, the Examiner states, "the specification...(is) silent regarding 'means for increasing flexibility of the substrate,' claim 14, line 5."

The Examiner clarifies his position with respect to this rejection in his response to arguments on page 5, last paragraph, stating, "applicant explains in page 7 of the amendment filed on 04/02/03 that the 'means for function which is means to increase the flexible connector' by using different material, thinning the material, or removing the material that does not make any senses, since Examiner had a question that what thing/element cause the 'means for'

function to be increase flexibility of the substrate. Nowhere in the specification teaches/describes the function of 'means for increase the flexibility of the substrate' [*sic*]."

Applicants find the Examiner's statement confusing due, first, to significant grammatical inconsistencies, second, to inaccurate quotation of applicants' remarks, and third, to an apparent failure on the part of the Examiner to recognize, or understand the proper use of the term of art, "means for," in a means-plus-function claim, as detailed in 35 U.S.C. § 112, sixth paragraph.

To the best of the applicants' understanding, the rejection seems to be based upon the Examiner's inability to find any reference in the specification that includes the actual words "means for." Thus, the Examiner has rejected the claims as being unsupported by appropriate language in the specification.

MPEP § 2181 states the following:

> A claim limitation will be interpreted to invoke 35 U.S.C. 112, sixth paragraph if it meets the following 3-prong analysis:
>
> (A) the claim limitations must use the phrase "means for" or "step for";
>
> (B) the "means for" ... must be modified by functional language; and
>
> (C) the phrase "means for" ... must not be modified by sufficient structure, material or acts for achieving the specified function.

The relevant limitation of claim 14 recites "means for increasing flexibility of the substrate in the contact region." Clearly, this limitation meets the three-pronged analysis set forth in the MPEP. Namely, (A) the phrase "means for" is used, (B) modified by functional language, and (C) without additional structure, material or acts for achieving the function. Accordingly, the phrase "means for" is used appropriately, and so, in itself, does not give rise to a rejection under § 112, second paragraph.

With respect to the other question raised by this rejection, namely, does the specification provide adequate support for the "means for increasing flexibility..." limitation of claim 14, applicants fully addressed this question in applicants' response to the Office Action of January 2, 2003, and also addresses it here.

Support in the original specification for the recitation of claim 14, of a "means for increasing flexibility of the substrate," is found throughout the specification and in the original

claims. Since it is so frequently discussed in the original claims and specification, applicants will point to only one clear quote from the specification, on page 6, beginning at line 4, which reads:

> according to the principles of the invention, a flexible connector is provided having a flexibility that varies over the surface of the substrate. It has greater flexibility in a localized region surrounding contact pads and greater stiffness over the rest of the connector. The greater flexibility may be provided by variations in substrate materials of the connector, or by thinning or removing selected amounts of the substrate of the connector in that region.

It is thus clear that the specification provides a description of at least three means to increase the flexibility of the connector: using different materials, thinning the material or removing the material.

Conclusion of Rejections under 35 U.S.C. § 112

The Examiner has erred in his understanding of 35 U.S.C. § 112, paragraph 6, and in his assertion that claim 14 is not supported by the specification.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, 4, and 6-8 were rejected under 35 U.S.C. § 102(b) as being anticipated by Stopperan (U.S. Patent No. 5,428,190).

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an ipsissimis verbis test, *i.e.*, identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990).

The Examiner has failed to present a *prima facie* case of anticipation of claims 1, 4, and 6-8. The Examiner erred in asserting that Stopperan teaches or enables each of the claimed elements, either expressly or inherently, of the invention as interpreted by one of ordinary skill in

the art. In particular, Stopperan fails to teach "a strain relief structure, positioned between two of the plurality of contact pads," as recited in claim 1, as will now be shown.

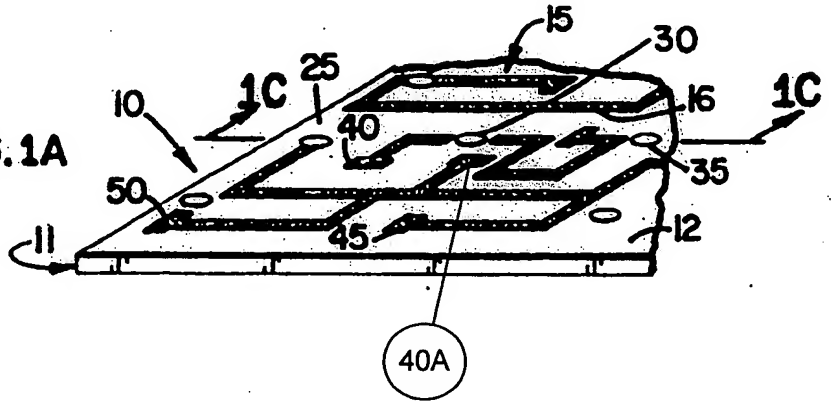

FIG. 1A

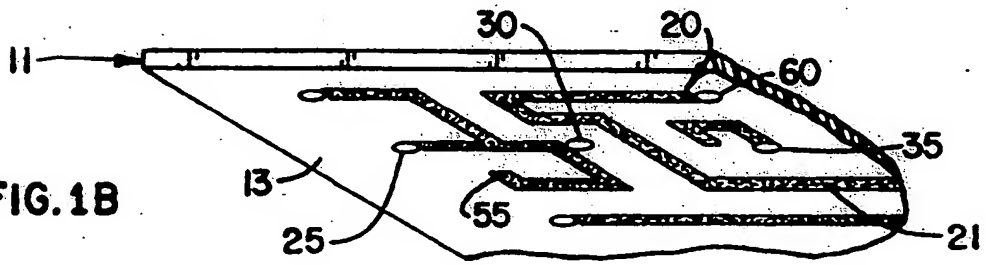

FIG. 1B

Stopperan discloses, as shown in Figures 1A-1C, and as discussed at column 8, lines 24-30, plated through holes (PTH) 25, 30, 35, configured to provide electrical connection between layers of the substrate 11. The Examiner has cited the plated through holes as being analogous to the strain relief structure of claim 1. In Stopperan, the contact pads are elements 40, 45, 50, 55, and 60 (see column 8, lines 7-8, lines 15, 16, and Figures 1A and 1B).

There are no apertures or strain relief structures of any type in-between these contact pads. One particular pair of contact pads are pads 40 and an unnumbered adjacent pad, which applicants have labelled 40A for reference in this appeal brief. These are two pads next to each other, yet there is no aperture or other strain relief structure between them.

Looking at the two numbered contact pads 45 and 50 from Stopperan, Figure 1A, again, there is no strain relief structure between them. It appears that the plated through holes 25, 30, 35 are placed in the circuit board according to the electrical connection to be provided and the

need to connect certain lines, not based on the ability to provide strain relief between contact pads. There are, in fact, no apertures in Stopperan positioned between any two contact pads. He just plain fails to show this claimed feature.

A second shortcoming of Stopperan is that the holes he provides are not strain relief structures, these are stiffening structures. The holes are plated with rigid metal, that makes them less flexible, not more flexible. Apparently, the Examiner has assumed that any aperture that passes through a substrate qualifies as a strain relief structure (note that claim 2 recites the limitation wherein the strain relief structure is an aperture penetrating through the flexible substrate). However, as explained in the summary of the invention above, the flexibility of a substrate is reduced by the portions of surface area occupied by inflexible metal structures.

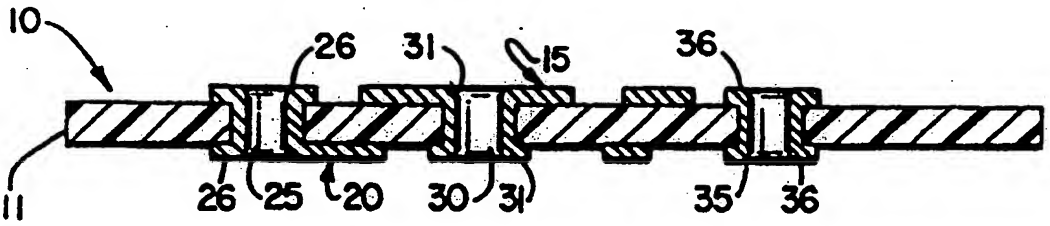

FIG. 1C

Clearly, the PTH structures, described with reference to Stopperan's Figure 1C, fall into the category of inflexible metal structures. Structures such as these will inherently reduce flexibility of the substrate upon which they are formed, due to the additional metal deposited on the surfaces of the substrate, as well as the metal barrel lining the holes. Thus, they cannot be regarded as providing strain relief, but, on the contrary, will tend to increase stiffness, and will localize strain at the edges of the metal surfaces during flexing of the substrate.

Stopperan offers no teaching to the contrary, stating only "if the thickness of the substrate 11 used is relatively thin ... the length of the copper barrels is therefore also only a few mils (the total thickness of substrate 11 and conductive layers 15 and 20), and thermal mechanical stress is never a problem ..." (column 8, line 65 through column 9, line 1). Stopperan does not regard the plated through holes of Figures 1A-1C as strain relief structures, but rather, considers it important that the substrate used be "relatively thin," so that a problem is not created, due to the

length of the copper barrels. This is not how one would describe a strain relief structure. Consequently, the Examiner was incorrect in citing the plated through holes as being equivalent to the strain relief structure of claim 1.

Claim 4 recites the strain relief structure as being "a thinned region of the flexible substrate." In rejecting claim 4, the Examiner did not cite a specific structure of Stopperan as being equivalent to the thinned region of claim 4, but rather cited column 7, lines 67 and 68 of Stopperan. The cited text reads, "typical thickness of an insulating substrate can be from about 12.5 to 125 microns for the flexible board and about 200 microns to 2400 microns." While the cited text does discuss ranges of thicknesses appropriate for the various substrates, there is no mention of a particular region of the flexible substrate that is thinned, nor is there a discussion of the relationship of such a region with respect to the location of the contact pads. Accordingly, the Examiner's rejection of claim 4 is inappropriate.

Claim 6 states "wherein the strain relief structure is centered on a line between centers of two of the plurality of contact pads."

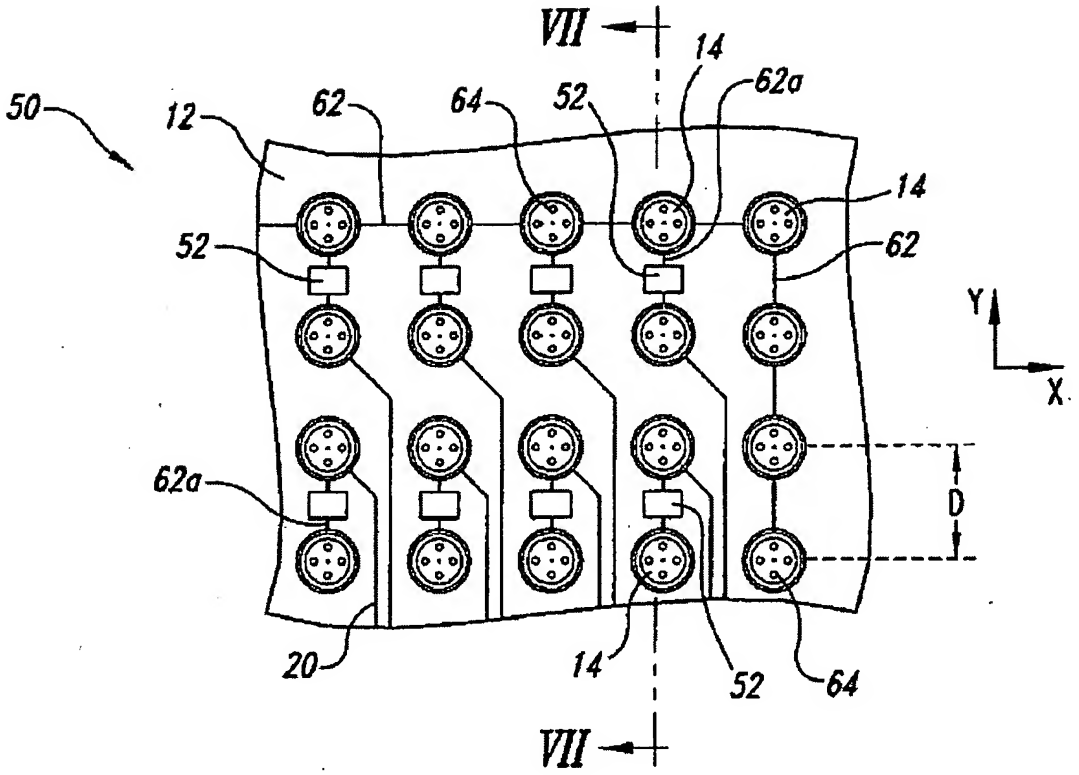

Fig. 6

Figure 6 of the present application, reproduced above, shows one of many embodiments upon which claim 6 reads. It may be seen that each of the strain relief structures 12 is positioned between two adjacent contact pads 54.

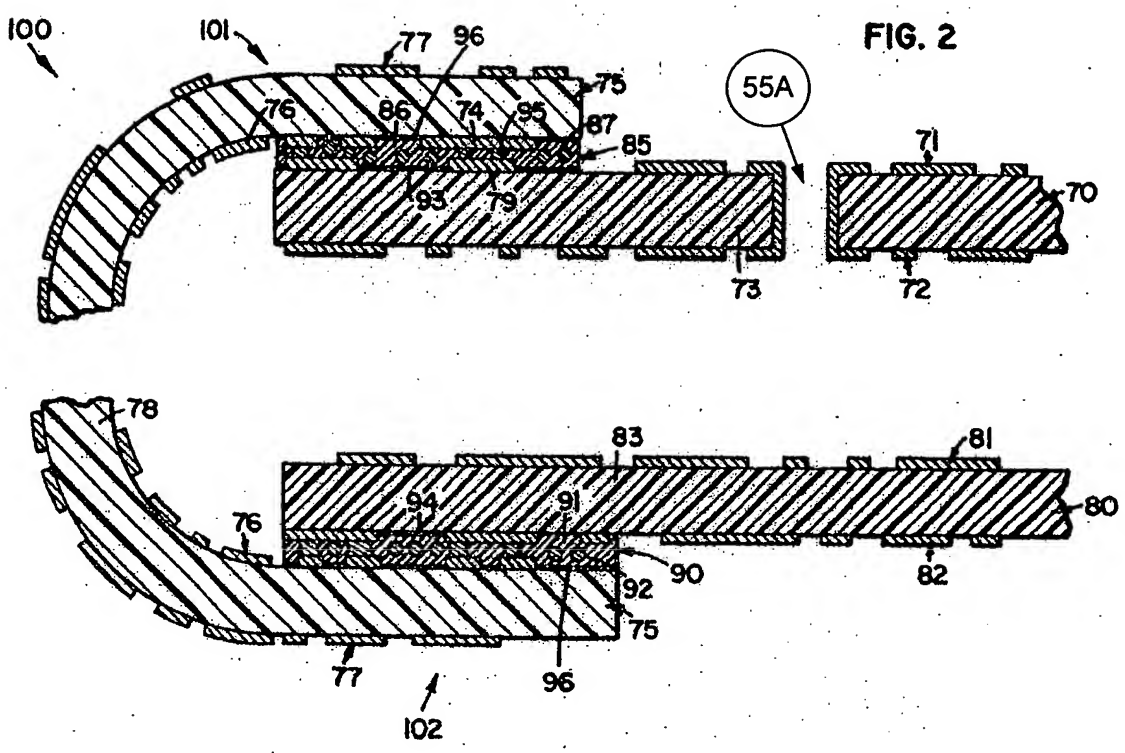

FIG. 2

The Examiner, in rejecting claim 6, cited Figure 2 of Stopperan as teaching the limitation thereof. This rejection is inappropriate. Referring to Stopperan's Figure 2, the only feature identified by Stopperan that may be remotely considered to be analogous to the contact pads of claim 1 (base claim to claim 6) is the interconnecting pad 74. Stopperan describes the interconnecting pad 74 as being configured to provide a connection between the circuits of flexible board 75 and those of rigid substrate 70 (see, for example, the description of Figure 2, and in particular column 15, lines 7-11, 29, 30). Even if we assume that there are more interconnecting pads than the single pad 74 identified on the flexible board 75, there are no structures identified in Figure 2 that may be considered analogous to strain relief structures, nor did the Examiner indicate any structures as being such.

The one aperture shown in Figure 2 of Stopperan is not numbered, in his figure, so applicants have added number 55A for reference in this appeal brief. Thus, even if 55A is considered a strain relief structure, which it is not, it is not between two contact pads.

Claim 8 recites "wherein the strain relief structure is positioned such that it interrupts one of the plurality of electrical traces." In rejecting claim 8, the Examiner again cites Figure 1 as teaching that limitation. Referring to Figure 1C of Stopperan, it may be seen that the plated through holes cited by the Examiner as being analogous to the strain relief structure do not interrupt the traces, but rather provide for their electrical continuity. Not only this, but they also provide electrical continuity with other layers of the substrate. Accordingly, the Examiner's rejection is in error.

Conclusion of Rejections Under 35 U.S.C. § 102

The Examiner has erred in asserting that Stopperan teaches each of the claimed limitations of claims 1, 2, 4, and 6-8 as interpreted by one of ordinary skill in the art. The Examiner has erred in asserting that the plated through holes of Stopperan are analogous to the strain relief structure of claim 1. The Examiner has erred in asserting that Stopperan teaches a strain relief structure comprising a thinned region of a flexible substrate. The Examiner has erred in asserting that Stopperan teaches a strain relief structure centered on a line between centers of two of a plurality of contact pads. The Examiner has erred in asserting that Stopperan teaches a strain relief structure positioned such that it interrupts one of a plurality of electrical traces. For at least these reasons, the Examiner has failed to present a *prima facie* case of anticipation of claims 1, 2, 4, and 6-8.

Rejections Under 35 U.S.C. § 103(a)

Claims 3 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,428,190 to Stopperan in view of U.S. Patent No. 3,977,074 to Furnival. Applicants believe the Examiner did not meet his burden to present a *prima facie* case of obviousness. In particular, the Examiner erred in combining Furnival with Stopperan. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings,

knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000).

Furnival does not show, and is not cited by the Examiner to show, the missing feature of a strain relief structure between contact pads. Furnival does not show contact pads or any apertures between them and thus does not teach this feature. Even if combined, Stopperan and Furnival fail to show the claimed invention.

The Examiner asserted that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a rectangular shape as taught by Furnival to employ the device of Stopperan in order to provide an interfacial connection which is inexpensive and more reliable." Thus, the Examiner asserts that the motivation to combine resides in an obvious understanding that the aperture of Stopperan would be less expensive and more reliable if made in the rectangular shape taught by Furnival.

This statement by the Examiner is incorrect. Stopperan teaches away from a combination with Furnival, inasmuch as the relevant portions of Stopperan are directed to a flexible interconnector, while Furnival is directed to a rigid circuit substrate. In response to this argument, when previously presented thereto, the Examiner stated, "Furnival teaches a printed circuit board made of dielectric materials disclosed in Figures 1-6, the dielectric material has properties as flexible as well [*sic*]." Apparently, the Examiner's point is that any circuit board has some degree of flexibility, and so may be regarded as falling within the scope of a claim reciting a flexible substrate.

While it may be true that there is virtually no substance on earth that can be considered to be absolutely rigid, or perfectly inflexible, one must consider the meaning of a term as understood by one having ordinary skill in the art. In the cases of Stopperan and Furnival, each reference provides an understanding of what is meant by the terms used. At column 4, lines 46-50, Stopperan states, "there is a need for a rigid-flex circuit board having at least one rigid board connected to at least one flexible interconnector that can be bent such that the rigid-flex board can be positioned to utilize space efficiently." One having ordinary skill in the art will understand the reference to a flexible connector in this statement as referring to a connector

having sufficient flexibility, for example, to connect between rigid circuit boards placed very closely together, and side by side within a computer. Stopperan's Figure 2 displays precisely this arrangement, in which rigid circuit boards 70 and 80 are connected together by flexible connector 75, which is shown doubled over on itself.

In contrast, Furnival teaches "a printed circuit substrate 10 preferably of the rigid variety ...." See column 2, lines 1, 2 of Furnival. Furnival itself teaches a flexible substrate 32 which bends to enter the aperture created by the punch-out of piercing tool 20. Thus even Furnival teaches that his substrate 10 is rigid, as compared to substrate 32, which is flexible. One having ordinary skill in the art will not interpret substrate 10 to be one of perfect rigidity, but rather to what is commonly known in the art as a rigid substrate, namely, a substrate that has a high degree of stiffness, and that can be used in an application where it must resist flexing, and remain substantially planar.

There can be no confusion as to the relative meaning of "flexible" vs. "rigid" in the context of Stopperan, Furnival or this invention. One of ordinary skill in the art would certainly not be motivated to combine a technology specifically designed for use with a flexible substrate, with an application requiring a substrate having a high degree of rigidity.

A combination of Furnival's interfacial connector with Stopperan's flexible jumper would render Stopperan unsatisfactory for its intended use.

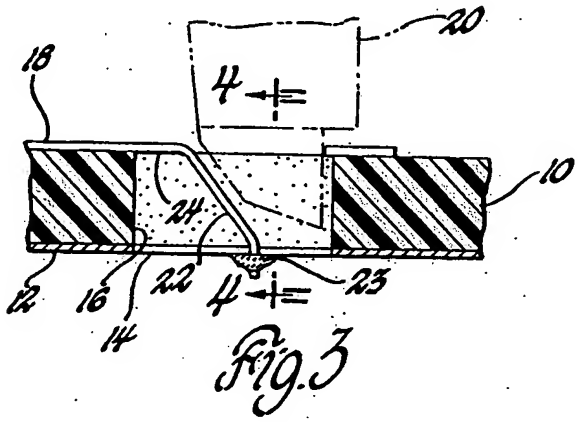

Fig.3

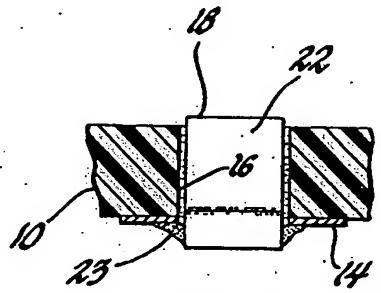

Fig.4

As shown in Furnival's Figure 3, Furnival is directed to a technology in which a hole is formed in a rigid substrate 10 having a conductive layer 12 on one surface. A second conductive

layer 18 is then applied to the opposite surface of the substrate 10, and a piercing tool 20 is employed to form a tab 22, which is forced through the hole and soldered on two edges to the conductive layer 12 on the opposite side. Viewing Furnival's Figures 3 and 4, it may be seen that the solder joint 23 is limited to a very short, narrow region on the edges of the tab 22. Accordingly, it would be obvious to one having ordinary skill in the art that such a connection would be inappropriate for use on a flexible connector, as the term is understood in the art, inasmuch as the extreme flexing of the connector would tend to break the solder joints 23. In particular, any twisting of the flexible substrate, as would be common in handling a flexible jumper such as Stopperan's, would almost certainly cause such a connection to fail. Thus, the proposed modification would render Stopperan unsatisfactory for its intended use.

If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

Claims 9-17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the prior art Figures 1 and 2, submitted by the applicants, in view of U.S. Patent No. 3,977,074 to Furnival. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970). If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

The Examiner has again failed to meet his burden to present a *prima facie* case of obviousness. The Examiner failed to show that the admitted prior art, Furnival, or a combination, teach or suggest all the claim limitations of independent claim 9, which recites "a plurality of apertures arranged in a regular configuration and intercalated into the plurality of contact pads." Claim 9 is particularly clear in the requirement for the apertures being "intercalated into the plurality of contact pads." This refers to the apertures being positioned in a regular pattern in-between adjacent contact pads. Certainly, this feature is not found in the

combination of Stopperan and Furnival. Neither Stopperan nor Furnival teach such features, even if the full teachings of both were combined.

Of course, the present application shows contact pads that are adjacent to each other. However, Furnival does not teach or suggest that an aperture, or any other structure to make the contact pads more flexible is to be positioned between the contact pads. Furnival is utterly missing in any suggestion to add an aperture at such a location.

The admitted prior art of the present application offers no suggestion as to how the problems outlined should be resolved, and certainly does not offer any suggestion as to the arrangement of strain relief structures. Meanwhile, Furnival does not offer any teaching with respect to a flexible connector, does not disclose contact pads of any sort, does not teach that apertures should be arranged in any particular arrangement or configuration, and does not suggest that such apertures would be of any use in increasing flexibility of a flexible substrate. Accordingly, the combination of the admitted prior art with Furnival fails to teach all the claim limitations of claim 9.

The rejection of claims 9-17 under § 103 of applicants' admitted prior art and Furnival must fail for additional reasons as will now be explained.

Figures 1 and 2 of the present application are directed to a flexible connector and the contact pads thereon. In contrast, as previously demonstrated, Furnival is directed to a rigid circuit board, and is not compatible with a flexible connector.

In addition, Furnival is further directed to structures configured to interconnect opposing surfaces thereof. The admitted prior art in the present application makes no reference to interconnection of opposing surfaces of the connector, while for his part, Furnival is silent on the question of connectors, contact pads, means, or motives for increasing flexibility of a substrate. Thus, in the first place, Furnival's fragile solder joints are not compatible with the flexible connector of the admitted prior art, and, in the second place, there is no common teaching or motivation to combine. Accordingly, the Examiner erred in combining Furnival with the admitted prior art.

Claim 10 of the present invention specifically calls for "forming between two of the plurality of contact pads, a strain relief structure. Certainly, Furnival does not teach that a strain

relief structure is to be formed between two contact pads. Of course, the admitted prior art is a plurality of contact pads on a flexible substrate; this has been well known in the art for many years. What has not been known, and what Furnival fails to show is that the reliability of the electrical connection can be increased by placing a strain relief structure, such as an aperture, in-between two contact pads. Furnival does not teach or suggest this particular feature and therefore, even if the two prior art references are combined, this claim feature is completely missing from such a combination. Further, as previously explained with respect to claim 9, there is no teaching to combine the references. All the reasons for the failure to teach a combination are not repeated here since they are made with respect to claim 9 and apply in the same regard for claim 10.

The Examiner failed to show that the admitted prior art in combination with Furnival teaches or suggests all the claim limitations of claim 14, which recites, *inter alia* "means for increasing flexibility of the substrate in the contact region." As previously demonstrated above in the argument for claim 9, the Examiner has failed to present a *prima facie* case of the obviousness of claim 14 over the admitted prior art in view of Furnival. In addition, Furnival is silent with respect to means for increasing flexibility of a substrate. Inasmuch as Furnival is directed to a structure for connecting conductive layers positioned on opposite sides of a rigid circuit board, and inasmuch as Furnival specifies that the board should preferably be rigid, it is clear that Furnival does not contemplate his disclosed invention being used for purposes of increasing flexibility.

The Examiner has erred in rejecting claim 15 over the admitted prior art in view of Furnival. Claim 15 recites a means for increasing flexibility comprising a plurality of apertures intercalated with the plurality of contact pads. There is no teaching or suggestion in either the admitted prior art or Furnival offering any direction with respect to the location of apertures relative to contact pads.

The Examiner has erred in rejecting claim 16 as being obvious over the admitted prior art, in combination with Furnival. Claim 16 recites a means for increasing flexibility comprising a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from a first surface to a selected depth. In addition to the previously presented

arguments with respect to the combination of the admitted prior art with Furnival, and with respect to the lack of teachings with respect to the location of the apertures, Furnival teaches only apertures penetrating completely through the rigid substrate. Nor is there any suggestion that apertures penetrating a selected depth might be employed, inasmuch as Furnival's structure requires complete penetration of the substrate for proper operation. Accordingly, the rejection of claim 16 is inappropriate.

The Examiner's rejection of claim 17 under 35 U.S.C. § 103(a) as being unpatentable over the admitted prior art in view of Furnival, is inappropriate. Claim 17 recites a means for increasing flexibility comprising a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region. The Examiner has failed to cite any specific structure or passage of Furnival that teaches or suggests a thinning of the substrate for any reason, let alone for increased flexibility. Furthermore, Furnival teaches a substrate that is preferably rigidly, thus teaching away from increased flexibility. For its part, the acknowledged prior art also fails to provide such a teaching. Accordingly, the rejection is inappropriate.

Conclusion of Rejections Under 35 U.S.C. § 103

Applicants believe that the Examiner has not met his burden of presenting a *prima facie* case of obviousness. The references have been inappropriately combined, and furthermore, the prior art of record does not teach each limitation of the present invention, nor does it suggest the limitations of the present invention. Therefore, applicants respectfully request consideration of allowance of the claims.

In conclusion, applicants believe that all claims are allowable in light of the prior and that a Notice of Allowance should be issued.

IX. CONCLUSION

In summary, applicants believe that the claims of the present invention are patentable, and not obvious in light of the combination of the cited references made by the Examiner. Allowance of the claims is respectfully requested.

Respectfully submitted,

Seed Intellectual Property Law Group PLLC

Harold H. Bennett II
Registration No. 52,404

HHB:jl

Enclosures:

Amendment After Final
1 Sheet of Replacement Drawings, Figures 5-6

701 Fifth Avenue, Suite 6300
Seattle, Washington 98104-7092
Phone: (206) 622-4900
Fax: (206) 682-6031

901115.435 \ 430213_1.DOC

APPENDIX A

X. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

1. (Original) A device, comprising:

a flexible substrate;

a plurality of contact pads on a first surface of the substrate; and

a strain relief structure, positioned between two of the plurality of contact pads.

2. (Original) The device of claim 1 wherein the strain relief structure is an aperture, penetrating through the flexible substrate from the first surface to a second surface.

3. (Original) The device of claim 2 wherein the aperture has, in plan view, a rectangular shape.

4. (Original) The device of claim 1, wherein the strain relief structure is a thinned region of the flexible substrate.

5. (Original) The device of claim 4, wherein the thinned region has, in plan view, a rectangular shape.

6. (Original) The device of claim 1, wherein the strain relief structure is centered on a line between centers of two of the plurality of contact pads.

7. (Original) The device of claim 1, further comprising a plurality of electrical traces, each of the plurality of electrical traces being in electrical contact with one of the plurality of contact pads.

8. (Original) The device of claim 7, wherein the strain relief structure is positioned such that it interrupts one of the plurality of electrical traces.

9. (Original) An electrical connector, comprising:

a flexible substrate;

a plurality of contact pads arranged in a regular configuration on a first surface of the substrate;

a plurality of electrical traces on the flexible substrate, each of the plurality of electrical traces being in electrical contact with a respective one of the plurality of contact pads; and

a plurality of apertures penetrating through the flexible substrate, the plurality of apertures arranged in a regular configuration and intercalated into the plurality of contact pads.

10. (Previously Presented) A method of manufacturing a flexible connector, comprising:

forming, on a first surface of a flexible substrate, a plurality of contact pads;

forming, on the flexible substrate, a plurality of electrical traces, each of the plurality of electrical traces being in contact with one of the plurality of contact pads; and

forming, between two of the plurality of contact pads, a strain relief structure.

11. (Original) The method of claim 10, further including breaking one of the electrical traces with the forming the strain relief structure step.

12. (Original) The method of claim 10 wherein the strain relief structure is an aperture penetrating the flexible substrate from the first surface to a second surface.

13. (Original) The method of claim 10, wherein each of the plurality of electrical traces is formed on either the first surface of the flexible substrate, a second surface of the substrate or an inner layer of the substrate.

14. (Previously Presented) A flexible connector, comprising:

a flexible substrate;

a plurality of contact pads formed on a first surface of the substrate and arranged in a regular configuration in a contact region of the substrate; and

means for increasing flexibility of the substrate in the contact region.

15. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to a second surface, opposite the first.

16. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a plurality of blind apertures intercalated with the plurality of contact pads and penetrating the flexible substrate from the first surface to selected depth.

17. (Previously Presented) The connector of claim 14 wherein the means for increasing flexibility comprises a thinning of the flexible substrate in the contact region, relative to a thickness of the substrate outside the contact region.